Gain-of-three amplifier requires no external resistors

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Analog Devices' ADA4862-3 comprises three wideband amplifiers, each configured by an internal, fixed-value resistive-feedback network as a noninverting gain-of-two amplifier. Due to its internal feedback networks, the device offers a bandwidth of 300 MHz and excellent insensitivity to stray capacitance, variations in pc-board layout, and proximity of other devices. According to its specifications, each of IC1's three internal amplifiers offers three gain configurations—two, one, or negative one (Reference 1). When you configure it for a gain of two, a cascade of two or three amplifiers yields gains of four or eight, respectively. If your application requires a gain of three, you can use the circuit in Figure 1. Amplifier A3 serves as an impedance converter with a net voltage gain of one and a low-impedance driver for A1's gain-setting network. Amplifier A2 provides a gain of two at its noninverting input.

In addition, A1 introduces the proper time delay (phase shift) in A1's inverting-input path and thus roughly equals the time delay in A1's noninverting signal path. This configuration improves the circuit's dynamic performance over that you can achieve when A1's inverting input connects directly to the input signal. A 4.7-pF chip capacitor that connects from voltage follower A3's output to ground reduces the voltage follower's output impedance at frequencies of 100 MHz and above to ensure A1's stability.

If you configure it as a differential amplifier, A1 amplifies the input signal by a factor of two at its noninverting input and by a factor of negative one at its inverting input. The final voltage at A1's output comprises the algebraic sum of both components: \( V_{\text{OUT}} = 4 \times V_{\text{IN}} - V_{\text{IN}} = 3 \times V_{\text{IN}} \). In a conventional voltage amplifier, reducing negative feedback increases the overall gain. In contrast, cascading amplifiers with negative-voltage-feedback networks only slightly reduces the circuit's bandwidth. The net gain decrease at a frequency of 65 MHz amounts to 0.1 dB, or approximately 1.15% of a single gain-of-two amplifier's dc gain. For the gain-of-three amplifier in Figure 1, the gain decrease at 65 MHz amounts to approximately 2.3% of the circuit's dc gain.

For the best high-frequency performance, connect the ADA4862's internal amplifiers as Figure 1 shows to minimize the lengths of the device's external interconnections. You can cascade additional ADA4862-3 ICs to produce any gain expressed as \( 3^M \times 2^N \), where M and N represent integers, including zero—that is, gains of six, nine, 12, and so on.

Reference